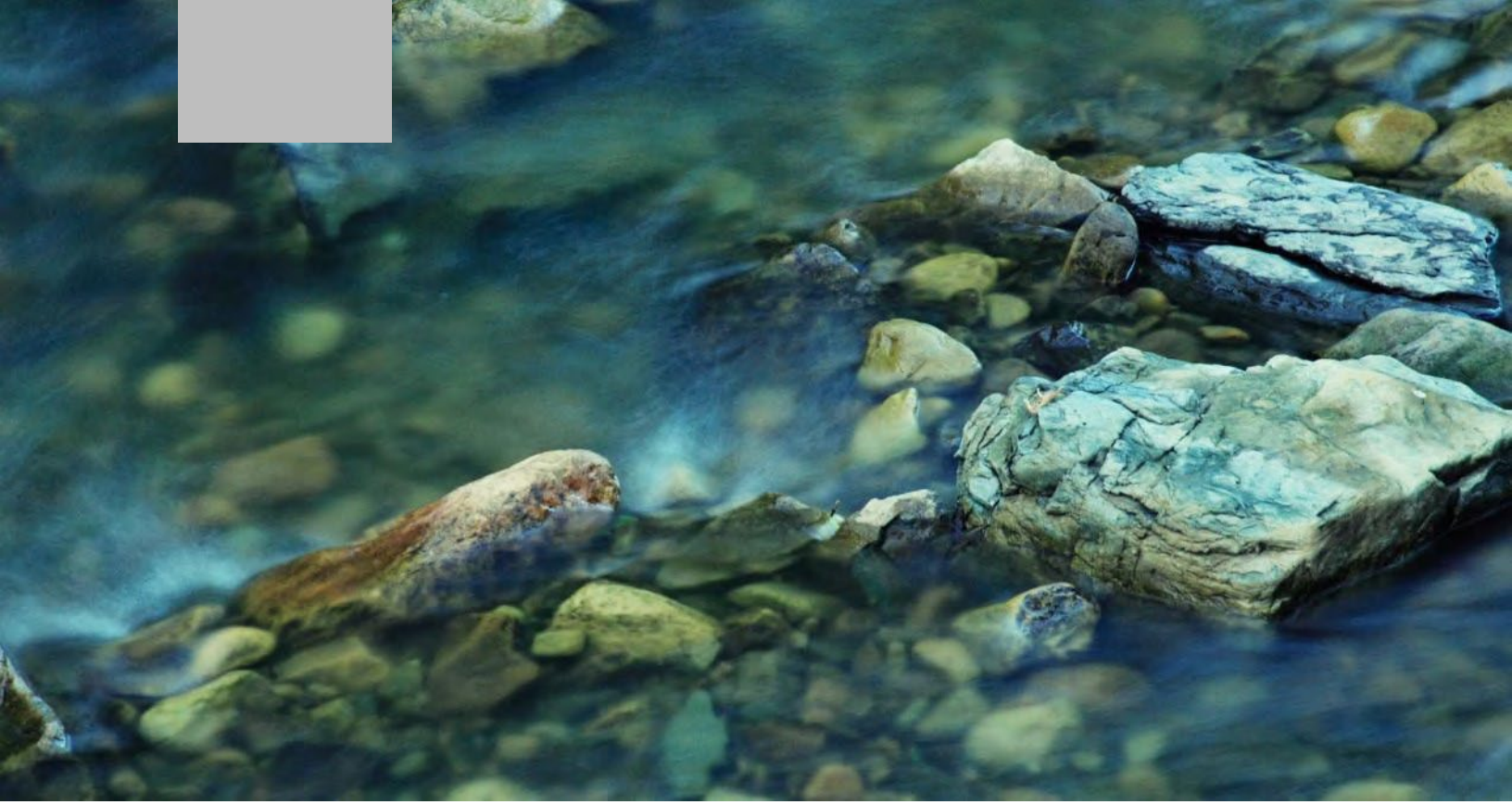

May 12, 2022
H&S Bosma Dairy Lagoon Nos. 1, 2, and 3
Administrative Order on Consent Docket No. SDWA-10-2013-0080

ANCHOR QEA

H&S Bosma Dairy
Lagoon Nos. 1, 2, and 3 Soil Sampling Plan

Prepared for H&S Bosma Dairy

May 12, 2022
H&S Bosma Dairy Lagoon Nos. 1, 2, and 3
Administrative Order on Consent Docket No. SDWA-10-2013-0080

H&S Bosma Dairy
Lagoon Nos. 1, 2, and 3 Interim Soil Sampling Plan

Prepared for
H&S Bosma Dairy
5860 East Zillah Drive Road
Granger, Washington 98953

Prepared by
Anchor QEA, LLC
1119 Pacific Avenue, Suite 1600
Tacoma, Washington 98402

Project Number: 210996-01.01

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APPENDICES

ABBREVIATIONS

bgs	below ground surface
CAFO	Concentrated Animal Feeding Operation
Consent Order	Administrative Order on Consent SDWA-10-2013-0080
Dairy	H&S Bosma Dairy
EPA	U.S. Environmental Protection Agency
H:V	horizontal to vertical (ratio)
TKN	Total Kjeldahl nitrogen
mg/kg	milligrams per kilogram
Plan	Lagoon Abandonment Plan
SVID	Sunnyside Valley Irrigation District
WA NRCS	Washington State Natural Resources Conservation Service

1 Introduction

H&S Bosma Dairy (the Dairy) will implement this sampling plan as required by the U.S. Environmental Protection Agency (EPA) Region 10 Administrative Order on Consent SDWA-10-2013-0080 (Consent Order).

The Dairy has implemented a program of lagoon consolidation and abandonments to reduce the number of its lagoons and the footprint of its lagoon system. As part of this ongoing work, the Dairy is proposing to abandon Lagoon Nos. 1, 2, and 3 (Figures 1 and 2) located in the southern portion of the Dairy.

This Plan describes the plan for sampling beneath Lagoon Nos. 1, 2, and 3 in support of future decisions regarding how to safely abandon the lagoons. Field work to abandon these lagoons must be completed by December 31, 2022.

Following sampling, the data will be transmitted to EPA for review.

The remaining sections of this Plan are organized as follows:

- **Section 2 – Existing Conditions.** This section reviews the current conditions of the Dairy and presents the approximate dimensions and current status of Lagoon Nos. 1, 2, and 3.
- **Section 3 – Sampling Procedures.** This section discusses how the nature and extent of nitrogen contamination beneath the lagoons will be assessed.
- **Section 4 –Schedule.** This section provides the project schedule.
- **Section 5 – References.** This section provides references for the materials cited in this Plan.

2 Existing Conditions

The Dairy is located at 5860 East Zillah Drive Road in Granger, Washington. Figure 1 shows the location of Lagoon Nos. 1, 2, and 3. Estimated dimensions and capacities of the existing lagoons are provided in Table 1.

2.1 Lagoon History

The three lagoons were dug into and along an historical stream bed. The Consent Order Dairies have identified the waterway as an "intermittent stream" and as Joint Drain 26-1.[1] The three lagoons are bounded by the intermittent stream/Joint Drain 26-1 to the west, the Sunnyside (irrigation) Canal to the south, and irrigated Bosma Dairy manure application crop fields to the north and to the east.

Prior to the 1990s, the Sunnyside Valley Irrigation District (SVID) operated an irrigation return water canal in the natural depression that conveyed irrigation return water from flood irrigation systems in the area back to the main SVID canal. That open ditch was piped (24-inch-diameter PVC pipe) and buried by SVID in the early 1990s. The approximate location of the current SVID irrigation return line is shown on Figure 2.

Impoundments at the location of Lagoon Nos. 1 and 2 were constructed first as tailwater ponds prior to the mid-1990s. At that time most of the fields in the vicinity were irrigated by flood irrigation. By 2005 the adjacent field had been modified to use modern pivot irrigation, and the three lagoons had been excavated to approximately their current dimensions. Copies of Google Earth images from 1995 and 2005 showing these changes are attached in Appendix A.

Since their conversion to full-service manure lagoons, Lagoon Nos. 1, 2, and 3 have been used to store liquid animal waste generated from Dairy operations. Liquids collected within the lagoons were stored and then pumped to application fields or other lagoons.

For the purposes of the Consent Order, the term "lagoon" includes animal waste lagoons and animal waste management or storage ponds. Lagoon Nos. 1, 2, and 3 have historically served as animal waste storage ponds that contained manure, runoff from land areas contaminated with animal waste, and waste liquids from manure processing and other process operations.

2.2 Lagoon Status

Between 2016 and 2021 the Dairy has undertaken a program to optimize its lagoon network. This has included the consolidation, lining, and in some cases expansion of the most appropriate lagoons (i.e., those with the best operational locations and those located in the most protective soil types).

[1] Quarterly Groundwater Monitoring Data Report, Yakima Valley Dairies, April, 2016, Figures 2a, 2b, 3a and 3b.

Smaller and inefficient lagoons have been abandoned. The Dairy has also conducted updates to its operations, eliminating one of its milking parlors and updating its manure and process water management. These changes have reduced the Dairy's generation of manure and process-area liquids.

The net effect of the Dairy's lagoon optimization program has been to reduce its needed lagoon count from 22 to 7. The Dairy's current lagoon network includes an operational capacity of 32.8 million gallons and an emergency capacity of 38.9 million gallons (Appendix B). The Dairy's actual manure and stormwater production volumes have ranged from 26.0 to 30.9 million gallons between 2019 and 2021. The Dairy includes a conservative 37-million-gallon estimate of manure and stormwater production in its current Dairy Nutrient Management Plan (DNMP).

Under the DNMP the Dairy requires a minimum winter storage capacity exceeding 4 months. Based on the conservative DNMP-based manure and stormwater production estimate, the Dairy's current winter storage capacity is more than 10.6 months without Lagoon Nos. 1, 2, and 3. Using emergency volumes, the lagoon capacity is 12.7 months.

Table 1 summarizes the current dimensions and capacities of Lagoon Nos. 1, 2, and 3. The Dairy has proposed to abandon these three lagoons because they are not needed for manure or stormwater management capacity and because they are located in a higher-risk geologic area with sandy soils and relatively shallow (30 to 35 feet below ground surface [bgs]) groundwater.

Table 1
Lagoon Nos. 1, 2, and 3 Approximate Dimensions and Capacity

Lagoon	Length (feet)	Width (feet)	Depth (feet)	Operating Capacity (million gallons)	Capacity (acre-feet)	Approximate Interior Side Slope
1	950	210	10	8.6	26.4	2H:1V
2	450	100	10	1.8	5.5	3H:1V
3	580	120	10	1.7	5.2	3H:1V

The current status of each lagoon is as follows:

- Field work to line or abandon Lagoon 3 was required to have been completed by December 31, 2021. The field work was not completed which is a violation of the Consent Order.
- Lagoon No. 3 was removed from use in early fall 2021 and was emptied of manure and liquids. The Dairy conducted soil sampling at Lagoon 3 without an approved plan in place, which is a violation of the Consent Order. The Dairy collected soil sampling data were collected from the base and sidewalls of the lagoon to depths of 10 feet bgs in November 2021 (Section 2.3 and Table 2). An abandonment plan was submitted to EPA for review in January 2022 (Anchor QEA 2022). In the meantime the Dairy has implemented a daily visual monitoring program (Photographs 1, 2, and 3). It has also installed two soil moisture sensors

in the bottom of the lagoon (Photograph 3) to provide real-time monitoring of soil moisture levels at depths of 1 foot, 3 feet, and 5 feet bgs. These soil moisture sensors are actively maintained by Agrimanagement, Inc.

- Lagoon No. 2 has been taken out of service, and liquid manure has been removed. Lagoon conditions as of April 4, 2022, are shown in Photograph 4. Lagoon No. 2 has been added to the Dairy's daily visual monitoring program along with Lagoon No. 3.
- Lagoon No. 3 has been taken out of service but still contains liquid and solid manure (Photograph 5).

Photograph 1
Condition of Lagoon No. 3 in December 2021 Following Manure and Liquids Removal

Photograph 2
Condition of Lagoon No. 3 as of April 4, 2022

Photograph 3
Condition of Lagoon No. 3 Soil Moisture Sensors as Installed

Photograph 4
Lagoon No. 2 as of April 4, 2022, After Liquids Removal

Photograph 5
Lagoon No. 1 as of April 4, 2022

2.3 Lagoon No. 3 Soil Sampling Data

Following removal of the manure, the Dairy conducted soil testing within Lagoon No. 3 and documented ammonia and nitrate concentrations in the subsurface soil. Testing was conducted at six locations within Lagoon No. 3, including one sample from the lower portion of each sidewall and two samples from the lagoon bottom. Figure 2 shows the actual sampling locations. As noted above, the Dairy conducted soil sampling at Lagoon 3 without an approved plan in place, which is a violation of the Consent Order. Field work to line or abandon Lagoon 3 was required to have been completed by December 31, 2021. The field work was not completed which is also a violation of the Consent Order.

Soil samples were analyzed in a single phase. Results of testing are summarized in Table 2. Results of soil testing demonstrated that ammonia and/or nitrate concentrations in excess of the target level (45 milligrams nitrogen per kilogram [mg N/kg]) were present at depths between 3 and at least 10 feet bgs, with an average depth of just over 6 feet. Depths exceeding the target level were greatest for the east and west sidewalls (sample stations SO-2 and SO-3), both of which exceeded the target level at the deepest depths (10 feet bgs) sampled. These locations will be resampled at deeper depths.

Table 2
Results of Initial Soil Testing at Lagoon 3

Station ID	Depth Range (inches)	Nitrate-N (mg N/kg)	Ammonia-N (mg N/kg)	Available N (mg N/kg)	Exceeds 45 mg N/kg?
S-01 (North Sidewall)	**0–12**	147.7	1.7	**149.4**	**Yes**
	12–24	89.5	ND (u)	**89.5**	**Yes**
	24–36	47.7	2.6	**50.3**	**Yes**
	36–48	93.8	3.1	**96.9**	**Yes**
	48–60	18.3	3.6	21.9	No
	60–72	17.3	2.9	20.2	No
	72–84	14.2	3.1	17.3	No
	84–96	28.8	2.6	31.4	No
	96–108	20.3	3.5	23.8	No
	108–120	30.4	3.6	34	No

Station ID	Depth Range (inches)	Nitrate-N (mg N/kg)	Ammonia-N (mg N/kg)	Available N (mg N/kg)	Exceeds 45 mg N/kg?
S-02 (West Sidewall)	**0–12**	26.8	97.5	**124.3**	**Yes**
	12–24	1.0	30.8	31.8	No
	24–36	1.0	23.1	24.1	No
	36–48	1.8	25.0	26.8	No
	48–60	28.5	25.2	**53.7**	**Yes**
	60–72	39.9	1.9	41.8	No
	72–84	51.6	3.3	**54.9**	**Yes**
	84–96	67.0	8.5	**75.5**	**Yes**
	96–108	41.7	ND (u)	41.7	No
	108–120	45.6	7.2	**52.8**	**Yes**
S-03 (East Sidewall)	**0–12**	83.3	ND (u)	**83.3**	**Yes**
	12–24	188.2	ND (u)	**188.2**	**Yes**
	24–36	103.1	ND (u)	**103.1**	**Yes**
	36–48	85.5	ND (u)	**85.5**	**Yes**
	48–60	131.3	4.2	**135.5**	**Yes**
	60–72	56.6	ND (u)	**56.6**	**Yes**
	72–84	44.6	2.3	**46.9**	**Yes**
	84–96	69.5	ND (u)	**69.5**	**Yes**
	96–108	76.7	1.8	**78.5**	**Yes**
	108–120	113.1	2.7	**115.8**	**Yes**
S-04 (South Sidewall)	**0–12**	5.9	67.9	**73.8**	**Yes**
	12–24	ND (u)	81.7	**81.7**	**Yes**
	24–36	ND (u)	61.6	**61.6**	**Yes**
	36–48	2.9	10.7	13.6	No
	48–60	21	21.6	42.6	No
	60–72	1.8	6.0	7.8	No
	72–84	6.6	5.0	11.6	No
	84–96	6.8	6.1	12.9	No
	96–108	3.4	4.5	7.9	No
	108–120	6.9	2.4	9.3	No

Station ID	Depth Range (inches)	Nitrate-N (mg N/kg)	Ammonia-N (mg N/kg)	Available N (mg N/kg)	Exceeds 45 mg N/kg?
B-N (North Bottom Sample)	**0–12**	23.7	251.3	**275**	**Yes**
	12–24	1.9	139.7	**141.6**	**Yes**
	24–36	15.4	128.6	**144**	**Yes**
	36–48	0.8	208	**208.8**	**Yes**
	48–60	ND (u)	20.5	20.5	No
	60–72	4.8	18.5	23.3	No
	72–84	1.1	32.6	33.7	No
	84–96	ND (u)	14.3	14.3	No
	96–108	1.4	10.1	11.5	No
	108–120	0.7	8.2	8.9	No
B-S (South Bottom Sample)	**0–12**	176.8	109.5	**286.3**	**Yes**
	12–24	6.0	92.8	**98.8**	**Yes**
	24–36	24.4	6.6	**31.0**	**Yes**
	36–48	11.2	65.2	**76.4**	**Yes**
	48–60	11.8	118.7	**130.5**	**Yes**
	60–72	45.6	10.3	**55.9**	**Yes**
	72–84	19.8	5.7	25.5	No
	84–96	9.8	5.6	15.4	No
	96–108	21.0	7.8	28.8	No
	108–120	15.4	10.1	25.5	No

3 Sampling Procedures

This section describes the overall lagoon sampling procedures, including the following:

- Liquids and organic solids removal
- Soil nutrient testing
- Abandonment plan resubmittal

The Lagoon 1, 2, and 3 Abandonment Plan describing final abandonment procedures will be submitted to EPA following sampling.

3.1 Liquid and Organic Solids Removal

Prior to sampling, Lagoon Nos. 1 and 2 will have liquids, organic solids, and vegetation (if present) removed. Liquids contained within the lagoon will be transferred to an in-service, lined lagoon or agronomically applied during a manure application.

After liquid removal, organic solids will be removed and placed in the composting area. Solids will be removed down to the current lagoon soil foundation material.

3.2 Soil Nutrient Testing

The Dairy must complete removal of liquids, organic solids, and vegetation before soil sampling can occur. Soil testing will be conducted at Lagoon Nos. 1 and 2 sampling locations shown in Figure 2. Because deep soil contamination has been found in Lagoon 3 to a depth of 10 feet, the clean soil horizon for these lagoons will be determined upon review of additional soil sampling data.

Soil nitrogen testing will include the six locations in Lagoon Nos. 2 and nine locations within Lagoon No. 1. As shown in Figure 2, the sampling locations include samples from the lower portion of each sidewall and multiple samples from the lagoon bottoms. Laboratory analysis of all soil samples from Lagoons 1, 2 and 3 will be performed by SoilTest Farm Consultants, Inc., a State of Washington-certified analytical laboratory, and a North American Proficiency Testing-accredited laboratory located at 2925 Driggs Drive, Moses Lake, Washington. Sample management, packing, shipment, analytical testing, quality assurance/quality control, and data validation protocols will be consistent with those defined in the *Dairy Facility Application Field Management Plan* (Anchor QEA 2018). Henceforth, all soil samples from Lagoons 1, 2 and 3 will be tested for:

- Ammonium (as nitrogen) by Western Coordinating Committee S-3.50
- Nitrate (as nitrogen) by Western Coordinating Committee S-3.10
- TKN by Western Coordinating Committee S-8.10

All samples taken at Lagoons 1, 2 and 3 will be tested for total Kjeldahl nitrogen (TKN measures the sum of ammonia and organic nitrogen) so that the quantity of organic nitrogen present in each soil

horizon can be estimated (organic nitrogen is estimated by subtracting the ammonia nitrogen value from the TKN value). TKN analysis will be performed on all soil samples.

The cleanup target for these lagoons is 45 mg N/kg measured as total nitrogen (organic N + ammonia-N + nitrate-N). Sampling at a sampling location can cease when a clean soil horizon or the water table is identified. Based on the Lagoon 3 SO-2 sample results, which show intermittent contaminated soil depths separated by soil depth up to three feet that meet the cleanup target, a clean soil horizon is hereby defined as *four consecutive soil feet that each meet the cleanup target*, provided there is no deeper sample that exceeds the cleanup target.

Tier 1 testing of Lagoons 1 and 2 will use a backhoe to quantify available nitrogen concentrations in soils at depths at one-foot increments between 0 and 10 feet bgs. Based upon recent results, a geoprobe will not be capable of penetrating to sufficient depths. All testing deeper than 10 feet bgs must use an auger drilling rig. Upon completion of sampling at each boring, borings shall be immediately grouted with bentonite from the lowest point of the boring to the land surface in accordance with WAC 173-160-460d, to prevent the rapid migration of nitrate through the vadose zone to the drinking water aquifer. Every sample will be collected and analyzed for organic N, ammonia-nitrogen, and nitrate-nitrogen, and all of the sample results from every sample shall be reported to EPA.

Soil sampling will be conducted from the interior of the lagoons using the following methods:

- Sampling at Lagoon 3:
  - Sampling will be performed at the two sampling locations in Lagoon 3 (SO-2 and SO-3 on the east and west sidewalls) that exhibited available nitrogen levels in excess of 45 mg N/kg at 10 feet bgs during previous soil testing (Table 2). At these two locations, soil nitrogen testing will be continued **to the water table** in one-foot increments, employing an auger drilling rig to collect samples from 11 feet deep to the water table. Upon completion of sampling, all soil borings shall be immediately grouted with bentonite from the lowest point of the boring to the land surface in accordance with WAC 173-160-460d, to prevent the rapid migration of nitrate to the drinking water aquifer. All Tier 1 samples will be analyzed for ammonia, nitrate, and TKN, and all of the data from all of the samples will be reported to EPA.
- Tier 1 Sampling at Lagoons 1 and 2:
  - A backhoe will be used to collect soil samples representative of each 12-inch interval of the soil column to depths of 10 feet bgs.
  - Samples will be collected at each 1-foot interval to a depth of 10 feet.
  - Sampling personnel will record the location and depth of each soil sample to the nearest inch.
  - After samples have been collected, the samples will be placed in appropriate containers, and a custody seal bearing the sampler's name or initials and date will also be placed

on the container.
  - All Tier 1 samples will be analyzed for ammonia-nitrogen, nitrate-nitrogen, and TKN.
  - Each test pit will be logged by a licensed geologist or professional engineer, and a test pit log will be prepared for inclusion in the abandonment plan.
  - All Tier 1 samples will be analyzed for ammonia, nitrate, and TKN, and all of the data from all of the samples will be reported to EPA.

- Tier 2 Sampling at Lagoons 1 and 2: Tier 2 sampling will be performed at each location where the target 45 mg N/kg total nitrogen (organic N + ammonia-N + nitrate-N) concentration has not been reached over four consecutive feet.
  - A soil auger rig will be used to collect soil samples representative of each 12-inch interval of the soil column from 11 feet bgs to the water table.
  - Sampling personnel will record the location and depth of each soil sample to the nearest inch.
  - After samples have been collected, the samples will be placed in appropriate containers, and a custody seal bearing the sampler's name or initials and date will also be placed on the container.
  - Each soil boring will be logged by a licensed geologist or professional engineer, and a boring log will be prepared for inclusion in the revised abandonment plan.
  - All soil borings shall be immediately grouted with bentonite from the lowest point of the boring to the land surface in accordance with WAC 173-160-460d to prevent rapid migration of nitrate to the drinking water aquifer.
  - All Tier 2 samples will be analyzed for ammonia, nitrate, and TKN, and all of the data from all of the samples will be reported to EPA.

Soil sampling data will be provided to EPA for each lagoon in a Transmittal Memorandum within 10 days of the Dairy's receipt of the data from the laboratory. Data for each lagoon are to be transmitted as they are completed (i.e., three transmittals are expected). All testing must be completed by July 1, 2022, with the data transmitted to EPA by July 10, 2022.

Based on the soil sample results from Lagoon 3, EPA may modify the Tier 2 soil sampling requirements for Lagoons 1 and 2.

3.3 Abandonment Plan

The Abandonment Plan for Lagoons 1, 2 and 3 will be resubmitted to EPA by August 1, 2022. That plan will include each of the following:

- Copies of all soil nutrient data as received from the laboratory and copies of associated data validation reports.
- A written proposal for final lagoon abandonment, including management of all soil

nitrogen exceeding the target level. All contaminated soils that exceed the target nitrogen level must be addressed through removal, treatment, and/or prevention of infiltration through any contaminated soil left in place.

- An updated plan-view contour map of the lagoons, including proposed interim (during) and final (after abandonment) grading contours. Control points shall be added by a licensed surveyor so that the existing drone survey can be mapped with confirmed elevation contours.
- Copies of all test pit and boring logs and a cross section beneath the lagoons on a north-south axis, including elevation, the vadose zone soil types, and the water table. That section shall incorporate data from the test pits and borings, along with existing data available from other project investigations as shown in the 2018 *Groundwater Monitoring Report*.
- A proposed schedule for completion of final abandonment, including expected time frames for addressing soil nitrogen levels.

3.4 Final Abandonment Procedures

The extent of contaminated soils as described by sampling at Lagoon Nos. 1, 2, or 3 will inform how the contaminated soils will be addressed to protect the drinking water aquifer. The Dairy has proposed to treat excess nitrogen by in situ soil treatment by cropping the soils with deep- rooted crops as described in Section 3.4.1. However, EPA has expressed concern about the timeliness and effectiveness of the crop treatment proposal. Method(s) to effectively address all deep soil nitrogen that exceeds the target concentration will be described in the abandonment plan.

Work associated with these lagoons will not result in the creation of any new open earthen lagoons, pits, or holes on Respondents' properties.

3.5 Completion Report

Following completion of soil treatment and final confirmation testing, Anchor QEA will prepare and submit a completion report. The report will include the following information:

- A short narrative describing the lagoon abandonment work completed
- Copies of construction photographs showing the lagoon after emptying and during soil containment or treatment.
- Results of all soil confirmation testing.
- Results of all soil moisture monitoring.
- Statement that the closure followed WA NRCS *Conservation Practice Standard 360 – Waste Facility Closure* (WA NRCS 2013a) practices.
- Documentation of site conditions following soil treatment.

4 Schedule

The proposed schedule for lagoon abandonment includes the following:

- **Lagoon No. 3 Soil Testing:** Complete auger sampling from 11 feet bgs to the water table by May 31, 2022.
- **Lagoon No. 2 Soil Testing:** Backhoe testing in from 1 to 10 feet bgs must be completed by May 31, 2022. If deeper testing is needed to reach a clean soil horizon, testing by auger to the water table must be completed by June 1, 2022.
- **Lagoon No. 1 Soil Testing:** Lagoon must be emptied by May 31, 2022. Backhoe testing in from 1 to 10 feet bgs must be completed by June 15, 2022. If deeper testing is needed to reach a clean soil horizon, testing by auger to the water table must be completed by July 7, 2022.
- **Abandonment Plan:** The Abandonment Plan for Lagoons 1, 2 and 3 shall be revised and resubmitted to EPA by August 1, 2022.
- **Final Abandonment Schedule:** Field work to line or abandon Lagoon 3 was required to be completed by December 31, 2021. Field work to line or abandon Lagoons 1 and 2 must be initiated by October 1, 2022 and completed by December 31, 2022.

This schedule in this section does not extend any of the deadlines missed by the Dairy last year with regard to Lagoon 3 planning and abandonment.

5 References

Anchor QEA (Anchor QEA, LLC), 2016. *Final Modified Lagoon Work Plan*. Prepared for Liberty Dairy, LLC/H&S Bosma Dairy. December 2016.

Anchor QEA, 2018. *Dairy Facility Application Field Management Plan*. Prepared for Cow Palace, LLC, George DeRuyter & Son Dairy, LLC/D&A Dairy, LLC/George & Margaret, LLC, and Liberty Dairy, LLC/H&S Bosma Dairy. February 2018.

Anchor QEA, 2021. *H&S Bosma Dairy Lagoon Nos. 1, 2 and 3 Abandonment Plan*. Prepared for H&S Bosma Dairy. May 27, 2021.

Anchor QEA, 2022. *H&S Bosma Dairy Lagoon 3 Abandonment Plan*. Prepared for H&S Bosma Dairy. January 18, 2022.

Ecology (Washington State Department of Ecology), 2017. Concentrated Animal Feeding Operation. National Pollutant Discharge Elimination System and State Waste Discharge General Permit. Issued: January 18, 2017.

WA NRCS (Washington State Natural Resources Conservation Service), 2013a. *Conservation Practice Standard No. 360 – Waste Facility Closure*. January 2013.

WA NRCS, 2013b. *Conservation Practice Standard No. 590 – Nutrient Management*. December 2013.

Figures

SOURCE: Aerial from Microsoft (Bing) 4/11/2018
HORIZONTAL DATUM: Washington State Plane South, NAD83, U.S. ft

0 600
Feet

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ANCHOR QEA

Figure 1
H&S Bosma Dairy Lagoon Map

Lagoon No.'s 1, 2 and 3 Abandonment Plan
H&S Bosma Dairy

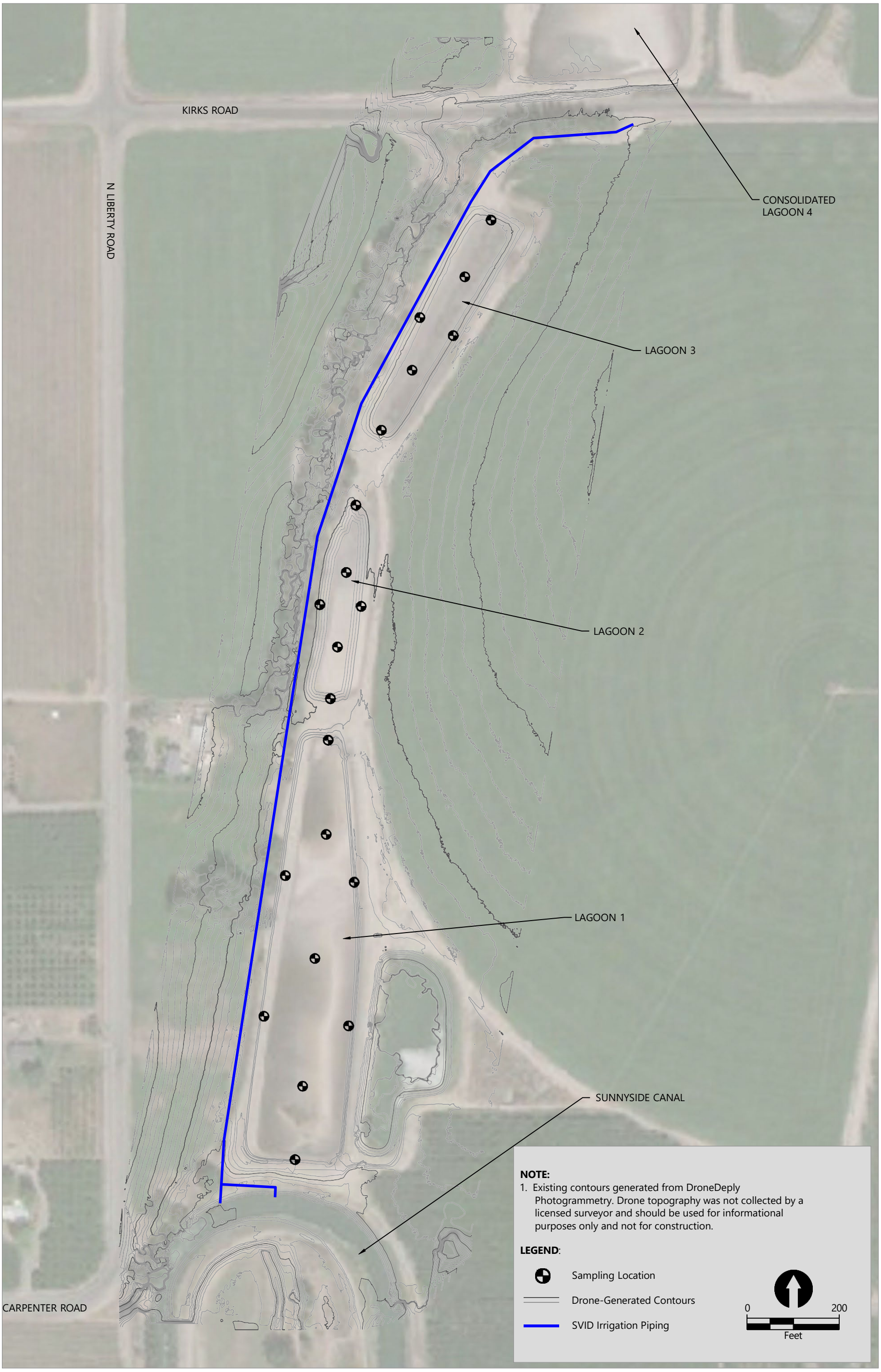

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Figure 2
Proposed Sampling Locations and Grading

Lagoon Nos. 1, 2, and 3 Abandonment Plan
H&S Bosma Dairy

Appendix A
Historical Aerial Photographs


Google Earth
1996 Photo
Legend
Kirks Rd
Kirks Rd
West Lateral
N Liberty Rd
N Arms Rd
Carpenter Rd
W Knowles Rd
Ditch Bank Rd
Google Earth
Image U.S. Geological Survey
N
1000 ft


Google Earth
2005 Photo
Legend
Kirks Rd
West Lateral
N Liberty Rd
N Arms Rd
enter Rd
W Knowles Rd
Knowles
Bank Rd
Google Earth
N
1000 ft

Appendix B
H&S Bosma Lagoon Capacity Evaluation

LIBERTY/BOSMA LAGOON CAPACITY ESTIMATION

DNMP Estimated Manure Production: 37 MG/yr

Annual Liquid Manure Production (Actuals)

2019 29.4 MG/yr
2020 26.0 MG/yr
2021 30.9 MG/yr

Required Minimum Storage: 4 month capacity

Available Capacity	**DNMP Estimate (mo.) [5]**	**Max of 2019-2021 (mo.) [4]**
At Operating Volumes:	10.6	12.6
At Maximum Volumes:	12.7	15.1

Lagoon ID	**Estimates of Initial Operating Volume (Prior to Lining and Abandonment)**			**Estimated Volumes Following Lining/Abandonment**	
	Column 1 Initial Vol Estimate (2016 Lagoon Work Plan) [1]	Column 2 Annual Report Estimates (2021 Annual Report) [2]	Column 3 **Updated Operating Estimate [3]** (Design & Completion Reports)	Column 4 Operational Volume (Completion Reports)	Column 5 Max Volume (Completion Reports)
Total Capacity (MG)	**56.2**	**55.5**	**39.2**	**32.8**	**38.9**
Manure Storage (MG)	**52.6**	**52.0**	**35.7**	**32.77**	**38.85**
1	14.4	14.4	8.6	0	0
2	2.6	2.6	1.8	0	0
3	4.3	4.3	1.7	0	0
4a	5.6	12.6	8.9	13.1	14.9
4b	4.1				
5	2.9				
6	3.8	2.45	2.3	2.74	3.48
7	2.5	4.5	1.1	3.94	4.5
12	0.7		0.6		
10	1	2.00	0.7	2.15	2.71
11	0.5		0.5		
13	0.7		0.5		
14	5.3	5.3	5.2	5.8	6.9
15	1.5	2.6	1.5	2.65	3.28
16	0.6		0.6		
17	0.5		0.5		
RWP	1.6	1.2	1.2	2.39	3.08
Compost-Area SW [4]	**3.6**	**3.5**	**3.5**	**0**	**0**
8	0.6	0.6	0.6	Abandoned	Abandoned
9	0.3	0.3	0.3	Abandoned	Abandoned
18	1.9	1.9	1.9	Abandoned	Abandoned
19	0.6	0.4	0.4	Abandoned	Abandoned
20	0.2	0.3	0.3	Abandoned	Abandoned

Notes:

MG: Million gallons

Lagoon capacities are shown in units of million gallons (MG). Manure production values are listed in units of million gallons per year (MG/yr).

1. The 2016 Lagoon Work Plan volume estimates were not based on surveys. They were based on preliminary measurements conducted by Inland Earth Sciences and have been shown to contain significant discrepancies from actual volumes. Improved estimates were later developed as part of the lining and abandonment process.

2. In most cases the initial volume estimates remained unchanged from those presented in the 2016 Lagoon Work Plan (this was requested by EPA for consistency with initial estimates). The volume estimate for Lagoons 7 and 12 is in error (the value shown is the post-construction maximum volume not the pre-construction volumes).

3. The updated volume estimates in Column 3 are based on survey data collected during the lining and abandonment process. These estimates include significant updates from the 2016 Work Plan Estimates.

4. The compost-area stormwater lagoons were never fully utilized. Their utility has been replaced by new stormwater management provisions. Excess storage capacity is available in the lagoon system if needed for trucked/pumped water from the compost-area stormwater systems.

5. The Dairy Nutrient Management Plan includes conservative literature-based estimates of manure production and estimates of stormwater production. These values are higher than actual manure and stormwater generation rates at the Dairy.